

Amendments to the Drawings:

Drawing Figures 1-3 are amended herewith in accordance with the Examiner's objection, set forth in section 2 of the current Office Action, requiring a legend "PRIOR ART" for these figures.

Included as attachments are replacement Sheets 1 and 2, which include figures 1, 2 and 3.

The only changes to the replacement sheets are addition of the legend "PRIOR ART" on each of Figures 1-3 in exact accordance with the instructions of the Examiner. As such, markup sheets showing changes would be superfluous, and the Examiner has not requested such. Markup sheets showing changes are therefore not provided herewith, but will be provided at the Examiner's request.

Attachments:

Replacement Sheets 1 and 2 (Figures 1, 2 and 3)

REMARKS

The Examiner objected to Drawing Figures 1-3 as each requiring identification as prior art. The replacement sheets attached hereto comply with the Examiner's instructions in this regard.

Prior to entry of the amendment set forth above, Claims 1-46 were pending, including eight independent Claims 1, 24, 41-46. The amendment set forth above changes neither the number nor type of claims, such that after entry Claims 1-46 remain pending, including eight independent Claims 1, 24 and 41-46.

No new matter is added by the present amendment. The application as filed fully supports the amendments. Examples of support for specific amendments are set forth below.

The first paragraph of the specification as presently amended is supported by the original first paragraph, and indeed is not changed substantively, but is amended to merely place it into a proper single-sentence form.

A primary amendment is clarification that an "inverse cost function" has "a value [...] which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases." Explanation of "inverse cost function" is clearly set forth in the Applicant's specification, particularly from page 28 line 18 to the end of page 30. The equation of line 24 on page 29 gives a general description of an inverse cost function for the subject invention, showing that the value increases proportionally to increases in power delivered to a desired receiver, and decreases proportionally to increases in interference power to proximate receivers.

While this is true of all relevant inverse cost functions, Equation 1 on page 30 demonstrates that inverse cost function embodiments need not conform precisely to such proportionality. As one example, A_k is an adjustment parameter that permits variation in the effect of interference delivered to particular receivers (see page 30 lines 6-9), as a consequence of which the function is not necessarily precisely inversely proportional to total interference power to non-target receivers. As a second example, the parameter "B" also permits the inverse cost function of Equation 1 to vary from direct inverse proportionality to the calculated interference power. Thus, an inverse cost function is clearly not limited to simple absolute proportionality or inverse proportionality requirements. However, in each of these examples it is at least true that the inverse cost function value increases as power calculated as being delivered to the target receiver increases, and

decreases as interference power calculated as being delivered to non-target receivers. That definition has accordingly been set forth in Claims 1, 42-44 and 46 to clarify the meaning of "an inverse cost function."

The amendments to Claim 24 are supported, for example, by Figures 4 and 5 and their accompanying text extending from page 13 line 17 to page 14 line 23. Figure 4 (and its accompanying text) describes the probing signal comprising alternatively-weighted signals at alternative times. Figure 5 (and its accompanying text) describes comparing the signals during these alternative times, based on signal strength. The signal strength comparison is based only on the estimate of the received signal (the "channel estimate"), which includes, without differentiation, all of the following: physical channel effects, any plural antennae arrangements and any weighting vector applied to such plural antennae. The comparison is thus entirely irrespective of any information describing particular weighting vectors. In preferred embodiments, indeed, the receiver is not provided with, and need not deduce, any such information. Thus, this probe-comparison technique avoids a necessity (or even a possibility, in some cases) for the receiver to consider information describing specific weight vectors, let alone to provide feedback reflecting such information. In desirable implementations, the technique can thereby greatly reduce both the computational burden on the receiver and the feedback data rate required to provide adequate feedback.

Rejections Over Harrison

In section 4 of the current Office Action, the Examiner rejects Claims 1-4, 9-10, 12-13, 24-26 and 29 as anticipated by Harrison. To support this rejection, the Examiner asserts that "The algorithm of the weight computer [of Harrison] is the inverse cost function." Harrison in fact makes no mention whatsoever of an inverse cost function, let alone in regard to the weight computer algorithm. As such, it must be concluded that the Examiner attributed no meaning whatsoever to the phrase "inverse cost function," despite the extensive explanation provided in the subject application. The amendment set forth above explicitly incorporates a definition of the phrase, which is derived from the Applicant's specification as explained in the remarks above.

Harrison is focused exclusively on the target (which he refers to as "subscriber") receiver for calculating appropriate weights. Harrison makes no mention of calculating, or even considering, the interference power in other (non-target) receivers (see, e.g., col. 4 lines 1-5 and lines 42-44). In particular, Harrison does not teach, disclose or fairly suggest "updating the weight vector set based on an inverse cost function, a value of which increases when power calculated as delivered to a target receiver increases and decreases when power calculated as delivered to non-target receivers increases," as required by Claim 1 as

presently amended. As such, Harrison clearly fails to anticipate Claim 1 as presently amended, and indeed does not render Claim 1 obvious. Claims 42, 44 and 46, as presently amended, include a very similar limitation, and thus are unanticipated by and nonobvious over Harrison for at least substantially the same reasons. Claims 2-23 properly depend from Claim 1, and are therefore nonobvious over Harrison at least by virtue of such dependency.

Claim 24 is amended herein to more clearly define the probe signal and feedback calculation methods of elements (c) and (d). As presently amended, Claim 24 requires in part (underlining added for emphasis): "c) generating a transmit probing signal including alternatively weighted signals transmitted at correspondingly alternative time periods based on the weight vector and parameter set for each receiver within a subset of tracked receivers; [and] d) generating feedback based on comparing reception, irrespective of information describing particular transmit weighting vectors, during the alternative time periods of the transmit probing signal generated in act (c) for each receiver within the subset of tracked receivers." Harrison does not teach, disclose, or fairly suggest these elements.

It will be useful to understand the functional value of the invention that is being claimed, for example, in Claim 24. Figure 5 illustrates a good example of a possible embodiment of the invention defined in Claim 24. In the embodiment of Figure 5, the feedback for each probing signal is truly minimal, consisting of just a single binary bit for each probing signal. The single bit indicates which of two time periods produced a larger signal. This minimizes the amount of data that is needed for feedback, helping to minimize receiver power consumption. Moreover, because CDMA receivers must constantly evaluate the power of the received pilot for other purposes, such as making handoff decisions, there is substantially no additional computational burden on the receiver. Compared with the complex requirements of Harrison, this simplicity minimizes both hardware complexity and power consumption in the receiver. The software complexity required (to integrate and compare the signal portion strengths, and to feedback the result) is also minimal. Thus, this invention may be implemented in a manner that is dramatically more efficient, in many regards, than a system such as described by Harrison, which requires information about specific weight vectors and provides feedback in regard to such specific weight vectors.

The Examiner will appreciate that Harrison (as with most conventional antennae weight vector adaptation techniques) bases the feedback on information describing particular transmit weighting vectors. Indeed, Harrison suggests that the mobile unit should actually direct the base station as to what weight vectors to use (see, e.g., col. 3 line 66 to col. 4 line 12). Recognizing that the need to communicate the weight vectors

places a large feedback data burden on the receiver, Harrison attempts to mitigate this problem by suggesting that both the base station and the mobile unit share knowledge of a "code book" of all possible weight vectors. That would be a large burden even for two-element arrays of transmit antennae, and would expand exponentially for multi-element arrays of transmit antennae. Appropriate embodiments of the Applicant's system, by contrast, remain able to be implemented with single-bit feedback regardless of the number of elements in the transmit antenna array employs, in significant part because the feedback is irrespective of information describing particular weight vectors.

Because Harrison fails to teach, disclose, or fairly suggest all of the features of Claim 24 as presently amended, Harrison clearly fails to anticipate, and also fails to render obvious, Claim 24 as presently amended.

Independent Claim 41 requires in part (underlining added for emphasis): "b) updating the plurality of baseband transmit weight vectors based on a metric of a cross interference and a plurality of channel estimates." The Examiner inadvertently neglected to point to any specific portion of Harrison as describing what might reasonably be called "a metric of a cross interference" for adjusting weight vectors. "Cross interference" is reasonably clear in referring to interference with other receivers. As noted above, Harrison describes calculations that consider only the target (subscriber) receiver, and thus cannot fairly be said to base weight vectors on a metric of a cross interference.

"Cross interference" is reasonably exemplified by the "cochannel gain matrix" that forms a part of Equation 2. A person skilled in the art will readily see that the cochannel gain matrix in Equation 2 represents a calculation of the interference power transmitted to proximate receivers other than the target, which is part (the denominator) of the general inverse cost function. It is the explicit consideration of interference to other receivers (cross interference) that enables some embodiments of the claimed invention to provide "nulling" of interference to receivers other than the target receiver. Thus, the metric of cross interference is a feature that distinguishes the invention claimed in Claim 41 from more conventional plural-antenna weighting systems, such as taught by Harrison, which focus only on the power delivered to a single target.

Independent Claim 45 also requires consideration of cross interference, which is not suggested at all by Harrison. As such, Harrison fails to anticipate either of independent Claims 41 or 45. Moreover, because the consideration of cross interference is not a matter of common practice, and is not suggested and motivated for a system such as that of Harrison, Claims 41 and 45 are nonobvious over Harrison.

The remarks set forth above require a conclusion that each pending independent claim of the subject application, at least as presently amended, is nonobvious and unanticipated by Harrison.

Rejections Under 35 USC § 112

In section 3 of the current Office Action, the Examiner rejects Claims 6-8, 11, 14-18, 20-23, 27-28, 30-31 and 35-40 under 35 USC § 112, second paragraph, as indefinite for comprising variables that are not defined in the claims. The Applicant respectfully traverses these grounds for rejection.

The claims must be interpreted in view of the specification. As those skilled in the mathematics of communications well know, the form of an equation defines relationships between the variables that strongly limit the scope of meaning that they can represent. Moreover, each of the equations in question is taken verbatim from the Applicant's specification, wherein each variable (except those that have standardized meanings in the field) is fully defined in a manner that renders the meaning of the equation, and thus the scope of the claim, entirely clear to one of skill in the art. As such, further definition of the variables is not needed to make the scope of the claims clear to one of skill in the art.

These rejected claims deal with complicated subject matter. They are not expected to be understood by one who is not skilled in the art. Conversely, their meaning will be entirely clear to one of skill in the art, in view of the specification. Only those whose products and methods read on one of the claims from which these equation-reciting claims depend need concern themselves with such claims. If a party is practicing one of the claims from which these claims depend, then it may fairly be assumed that the party includes persons of skill in the requisite art, and that they will read the specification. It is to such persons that the claims are directed; and it is respectfully submitted that, for such persons, the claims are not only sufficiently clear but highly precise.

The Examiner's attention is directed to MPEP § 2173.02, particularly paragraphs 1-3. It is respectfully submitted that the claims, as originally filed, when taken as a whole in view of the specification by one of ordinary skill in the art, clearly "appraises one of ordinary skill in the art of its scope and, therefore, serves the notice function required by 35 USC 112, second paragraph, by providing clear warning to others as to what constitutes infringement of the patent." As such, the Examiner is respectfully requested to withdraw the clarity rejections based on the presence of equations that must be understood in view of the specification.

VIA-016-CIP (LSI-004-CIP)
Appln. No. 11/073,377

Submission Date: December 13, 2005
Response to Office Action of September 13, 2005

Conclusion

It is respectfully submitted that the amendment and remarks set forth above overcome each grounds of rejection set forth by the Examiner. As such, the Examiner is respectfully requested to reconsider the application, to withdraw all previous rejections, and, barring the discovery of new grounds for rejection, to promptly issue a Notice of Allowance of all claims.

The Commissioner is authorized to construe this paper as including a petition to extend the period for response by the number of months necessary to make this paper timely filed. Fees or deficiencies required to cause the response to be complete and timely filed may be charged, and any overpayments should be credited, to our Deposit Account No. 50-0490.

Respectfully submitted,

12/13/2005
Date: December 13, 2005

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